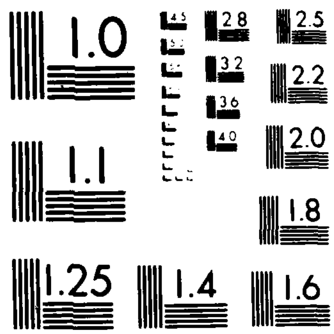
AD-A186 931 BRAIN POTENTIALS AND PERSONALITY: A NEW LOOK AT STRESS SUSCEPTIBILITY(U) HUMAN ENGINEERING LAB ABERDEEN PROVING GROUND MD L F MULLINS ET AL SEP 87 1/1

UNCLASSIFIED HEL-TM-20-87 F/G 6/10 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU [illegible] STANDARDS [illegible]

Technical Memorandum 20-87

BRAIN POTENTIALS AND PERSONALITY: A NEW LOOK AT STRESS SUSCEPTIBILITY

Linda F. Mullins
Jeffrey H. Lukas

September 1987
AMCMS Code 611102.74A0011

Approved for public release;
distribution is unlimited.

U. S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188
Exp Date Jun 30, 1986

1a REPORT SECURITY CLASSIFICATION
Unclassified

1b RESTRICTIVE MARKINGS
A186 931

2a SECURITY CLASSIFICATION AUTHORITY

3 DISTRIBUTION/AVAILABILITY OF REPORT
Approved for public release; distribution is unlimited.

2b DECLASSIFICATION/DOWNGRADING SCHEDULE

4 PERFORMING ORGANIZATION REPORT NUMBER(S)
Technical Memorandum 20-87

5 MONITORING ORGANIZATION REPORT NUMBER(S)

6a NAME OF PERFORMING ORGANIZATION
Human Engineering Laboratory

6b OFFICE SYMBOL (If applicable)

7a NAME OF MONITORING ORGANIZATION

6c ADDRESS (City, State, and ZIP Code)
Aberdeen Proving Ground, Maryland 21005-5001

7b ADDRESS (City, State, and ZIP Code)

8a NAME OF FUNDING/SPONSORING ORGANIZATION

8b OFFICE SYMBOL (If applicable)

9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c ADDRESS (City, State, and ZIP Code)

10 SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO	TASK NO	WORK UNIT ACCESSION NO
6.11.02.A	1L161102B74A		

Accession For
NTIS GRA&I
DTIC TAB
Unannounced
Justification
By
Distribution/
Availability Codes
Dist | Avail and/or Special
A-1

QUALITY INSPECTED 4

11 TITLE (Include Security Classification)
BRAIN POTENTIALS AND PERSONALITY: A NEW LOOK AT STRESS SUSCEPTIBILITY

12 PERSONAL AUTHOR(S) Linda F. Mullins
Jeffrey H. Lukas

13a TYPE OF REPORT
Final

13b TIME COVERED
FROM ________ TO ________

14 DATE OF REPORT (Year, Month, Day)
September 1987

15 PAGE COUNT
18

16 SUPPLEMENTARY NOTATION

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP
06	10	
05	08	

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Augmenting-Reducing
Sensation Seeking
Auditory Evoked Potential

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

Today's soldier is confronted with physiological and psychological hardships that can affect the soldier's ability to function effectively and appropriately. This is seen as a breakdown of performance when sustained stress exceeds the soldier's capacity to cope. This experiment investigates an underlying constitutional factor, involving the central nervous system, that plays a role in how excitable an individual will be during any stressful or arousing situation.

(see reverse side)

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT
☐ UNCLASSIFIED/UNLIMITED XX SAME AS RPT ☐ DTIC USERS

21 ABSTRACT SECURITY CLASSIFICATION
Unclassified

22a NAME OF RESPONSIBLE INDIVIDUAL
Doris S. Eanes

22b TELEPHONE (Include Area Code)
301-278-4478

22c OFFICE SYMBOL
SLCHE-SS-TS

DD FORM 1473, 84 MAR

83 APR edition may be used until exhausted
All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

19.

Subjects listened to 1,000-Hz tone bursts ranging from 40 to 85 dB sensation level (SL) in 5-dB steps in a block-randomized fashion. The brain's electrical response to the tones was averaged and collected on-line. The peak amplitudes were measured and the slope of the line of best fit between evoked potential amplitude and intensity was computed. Auditory augmenters have positive slopes, that is, as intensity increases so does the evoked potential amplitude. Reducers show the opposite effect. The brain potentials become smaller or reduce as intensity increases, producing a negative slope. In addition, each subject completed Zuckerman's Sensation Seeking Scale (SSS) and Vando's Reducer-Augmenter (R-A) Scale. The slope measure was significantly correlated with the experience seeking subscale of the SSS. The results indicate that auditory augmenters prefer and seek out novel and exciting experiences. And in conjunction with previous human and animal research, the results also suggest that the augmenter may cope better with stress and high workloads.

AMCMS Code 611102.74A0011 Technical Memorandum 20-87

BRAIN POTENTIALS AND PERSONALITY: A NEW LOOK AT STRESS SUSCEPTIBILITY

Linda F. Mullins
Jeffrey H. Lukas

September 1987

APPROVED:
JOHN D. WEISZ
Director
Human Engineering Laboratory

U.S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland 21005-5001

CONTENTS

BRAIN POTENTIALS AND PERSONALITY: A NEW LOOK AT STRESS SUSCEPTIBILITY

INTRODUCTION

This research program studies one of the key problems concerning soldier performance during stressful situations. It examines the underlying neurophysiological basis for individual differences in response to stress and the ability to cope with that stress effectively. Although the psychological and physiological effects of stress have been well-documented (Grinker & Speigel, 1945), the individual differences that underlie effective behavior in stressful situations are not well-understood and remain a problem for predicting human performance. This is especially pertinent in the selection of military personnel who must function effectively in a variety of stressful situations ranging from a radar operator monitoring a complex audiovisual display to a front line commander and his troops during combat. Military personnel are expected to respond effectively in all situations maximizing the probability of successful completion of all operations. Nevertheless, some individuals cannot cope during a stressful or challenging situation (Grinker & Speigel, 1945). The reasons for individual differences in coping behavior are not known. However, an ongoing line of research indicates that an underlying constitutional factor involving the central nervous system plays a key role in how excitable a person will be during any stressful, arousing, or challenging situation. Internal modulation of sensory experience is one factor that may account for differences in how an individual perceives and thereby responds to a situation.

Petrie (1967) introduced this line of research with the kinesthetic figural after-effects (KFA) test, a tactile-size judgment task, measuring individual differences in perceived intensity of sensation. Blindfolded subjects ran the thumb and forefinger of their dominant hand over a test block. Their task was to judge the width of the test block by rubbing a tapered block until they reached a width equal to that of the test block. Some individuals, called augmenters, perceived the test block to be larger following a period of tactile stimulation while other individuals, called reducers, perceived the test block to be smaller (Petrie, Holland, & Wolk, 1963; Petrie, McCulloch, & Kazdin, 1962). Petrie attributed this to the existence of a central nervous system control mechanism that regulates the intensity of sensory input.

Buchsbaum and Silverman (1968) developed a procedure using the brain's response to sensory stimuli called evoked potentials that appeared to establish a neurophysiological measure of stimulus intensity modulation. The relationship between stimulus intensity and the evoked potential is measured by calculating the slope of the line of best fit between evoked potential amplitude and intensity. Augmenters have positive slopes indicating that the evoked potential amplitude increases with intensity; reducers have less positive or negative slopes due to decreasing amplitudes at higher intensities. Buchsbaum and Silverman (1968) found that evoked potential reducers were also reducers on the KFA test. They hypothesized that reducers have hypersensitive nervous systems and respond strongly to

minimal intensity levels and thereby require "compensatory adjustments" to protect themselves from high intensity stimulation.

Many studies have related visual augmenting-reducing to a number of behaviors and personality traits, suggesting that this measure of cortical functioning indicates how individuals will respond behaviorally. One personality dimension of interest here is sensation seeking. Zuckerman (1979b) designed the Sensation Seeking Scale to assess individual differences in the optimal level of stimulation or arousal required by an individual. Visual augmenters were sensation seekers indicating they needed and sought out a higher level of stimulation than reducers[1] (Buchsbaum, 1971; Lukas, 1987; Zuckerman, Murtaugh, & Siegel, 1974). Zuckerman et al. (1974) attributed this to the existence of a reticulo-cortico-reticular negative feedback loop that maintains an individual's level of arousal within an optimal range. Reducers have a lower threshold for initiation of this inhibitory process thereby guarding against sensory overload. This lower threshold for inhibition is manifested behaviorally by a reduced propensity for seeking novel experiences.

Other research in this area found that augmenter cats reacted in an aggressive manner towards aversive, threatening stimuli; whereas, reducers remained passive or cowered in a corner (Lukas & Siegel, 1977b). Augmenter cats were also more explorative and active which appears analogous to the sensation-seeking behavior of human augmenters. In a separate animal experiment, Lukas and Siegel (1977a) observed that cats with reduced cortical responsiveness (reducers) were unable to cope with aversive noise during a food-rewarded task. Other cats explored the speakers and then resumed their normal behavior, whereas reducers were totally disrupted by the noise and attempted to escape. Reducers were able to continue with appropriate goal-directed behaviors only after prolonged noise exposures. In addition, Lukas and Mullins (1985) used a task requiring the subject to keep track of up to four items simultaneously and found augmenters performed better than reducers under high cognitive workloads. Based on these results, augmenters may perform better under high arousal and high workload situations including combat. Therefore, this research focused on developing techniques for assessing human cortical functioning in order to predict performance under stress and to form a screening device to select soldiers better able to cope.

The concept of a central controlling mechanism for stimulus intensity modulation implies that augmenting-reducing is a trait dimension and therefore independent of which sensory modality is tested. Two studies have failed to find a significant correlation between visual and auditory augmenting-reducing recorded from the same subjects (Kaskey, Salzman, Klorman, & Pass, 1980; Raine, Mitchell, & Venables, 1981). In fact, they found little evidence for auditory reducing. However, others have reported

[1] Zuckerman et al. (1974) found this effect to be strongest for the disinhibition subscale of the Sensation Seeking Scale. High disinhibitors had significantly larger visual evoked potential (VEP) amplitudes at the highest stimulus intensity.

examples of auditory evoked potential (AEP) reducing (Coursey, Buchsbaum, & Frankel, 1975; Schechter & Buchsbaum, 1973) and indicated that insomniacs were more likely to be AEP reducers and nonsensation seekers (Coursey et al., 1975). The purpose of the present research is to determine the prevalence of auditory reducing in normal subjects and to explore the relationship between auditory augmenting-reducing and sensation seeking. If the relationship between auditory augmenting-reducing and behavior is not modality specific then auditory augmenters should be sensation seekers, further supporting the concept of a central mechanism regulating sensory input and consequently behavior.

METHOD

Subjects

Thirty subjects, 27 males and 3 females, 18 to 50 years old, participated in this experiment. All subjects had normal audiograms and were not taking any drugs or medication. Ten subjects whose evoked potential data were unreliable and difficult to measure were excluded from the final analysis. Previous experiments conducted by Mullins and Lukas have had a similar proportion of subjects excluded because of noisy data. The distribution of personality scores for the excluded subjects was similar to the scores that were included. That is, excluded subjects consisted of both high and low sensation seekers.

Stimuli

Auditory stimuli consisted of 1,000-Hz tone pips with a duration of 25 milliseconds and a rise-fall of 5 milliseconds. Tone pips were delivered binaurally at a rate of 1 per second through Sennheiser HD 414-13 headphones. Each subject's threshold was determined for the 1,000-Hz tone pips and based on this, two block-randomized series were established. A series consisted of five intensities, each repeated 100 times. Stimuli were block-randomized by intensity, so that two stimuli of the same intensity never occurred consecutively. The low-intensity series ranged from 40 to 60 dB sensation level (SL) and the high-intensity series covered 65 to 85 dB SL, in 5-dB steps. Each intensity series was presented twice and counterbalanced. Tone pips were generated by a voltage controlled oscillator in series with a programmable attenuator, rise-fall gate, and audio mixer amplifier. Tone-pip frequency was analyzed by performing a spectral analysis on pure tones passed through a calibrated microphone in a Brüel & Kjaer Type 4153 artificial ear. The equipment was calibrated each day at 85 dB sound pressure level (SPL) using an artificial ear and a Brüel & Kjaer Type 2605 microphone amplifier.

Physiological Recordings and Apparatus

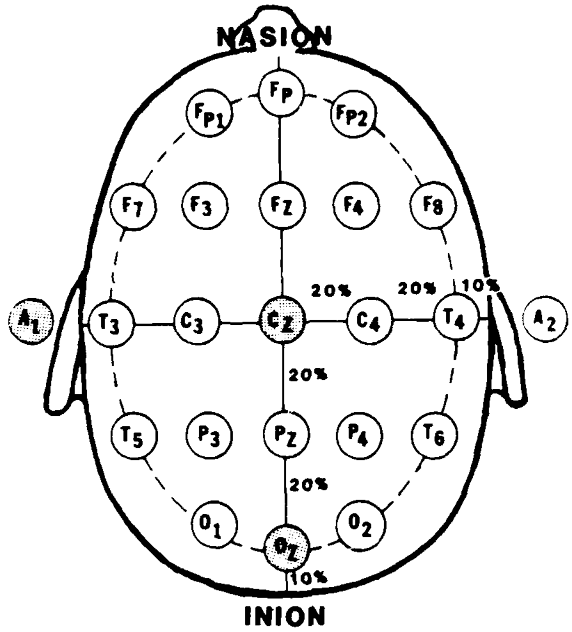
The evoked potential is an electrical response of the brain to sensory stimuli. Data are computer-averaged so that the brain's response, which is time-locked to stimulus onset, increases in amplitude while the ongoing EEG, which is not synchronized with the stimulus, is canceled out. Auditory evoked potentials were simultaneously recorded from C_zA_1 and C_zO_z electrode configurations with A_2 serving as ground (Figure 1). Electrode sites were cleaned with alcohol and Grass gold electrodes were attached with collodion. Electrode impedance was maintained below 5 kilohms. The EEG was amplified 10,000 times and bandpass filtered between 1 to 100 Hz. AEPs were averaged and sorted on-line until 100 sweeps were collected for each intensity. The artifact reject mode was used to eliminate sweeps contaminated with eye blinks or muscular activity.

Procedure

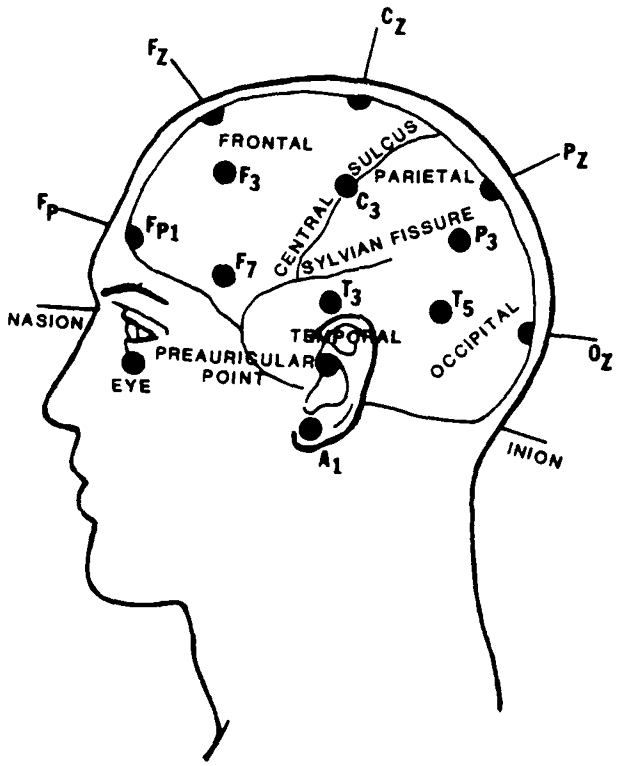
Following an explanation of the experimental procedures, such as the application of electrodes, subjects signed a volunteer consent form. Audiograms were collected and only those subjects who had normal audiograms ($\pm$ 10 dB) participated in the study. After electrodes were applied, subjects reclined comfortably on a cot in an electrically shielded, sound-attenuated Industrial Acoustics Company chamber. Subjects were instructed on the need for complete relaxation and lack of muscular activity. They were requested to keep their eyes open, to restrict blinking, to maintain fixation on a centrally located focal point, and not to move the headset. A television monitor was used to assure that subjects complied with these instructions. The lights were dimmed and the subject indicated when ready to begin. After completion of the first two intensity series, subjects were given a break and completed the Vando Scale and Form V of Zuckerman's Sensation Seeking Scale (SSS). The SSS consists of 10 items for each of 4 factors: thrill and adventure seeking (TAS) that measures interest in physical risk-taking activities such as parachuting; experience seeking (ES) reflects interest in music, art, drug use, and a spontaneous life-style; disinhibition (Dis) measures a hedonistic, extraverted lifestyle including drinking, parties, sex, and gambling; boredom susceptibility (BS) indicates an aversion to routine activities or boring people. A total score is based on all 40 items. The Vando Reducer-Augmenter (R-A) Scale (Vando, 1974) was developed to measure Petrie's conceptualization of stimulus intensity modulation and has been found to significantly correlate with Zuckerman's SSS (Goldman, Kohn, & Hunt, 1983; Kohn & Coulas, 1985).

Electrode impedance was checked before the subjects returned to the experimental chamber to complete the last two intensity series. AEPs were stored on disks for later analysis. The entire testing session lasted less than an hour.

Latency and peak-to-trough amplitude measurements for the P1, N1, and P2 components were obtained by positioning two cursors along the AEP. Data were plotted and examined to ascertain that appropriate and consistent components were measured across the entire intensity range (Figure 2). An average of the two repetitions was used for statistical analysis.



ELECTRODE PLACEMENTS



RELATIONSHIP BETWEEN MAJOR CORTICAL AREAS AND ELECTRODE PLACEMENTS (LEFT VIEW)

Figure 1. Electrode placements for the ten-twenty electrode system of the International Federation. (Odd numbers refer to the left side, even numbers refer to the right side. The present study used C_z in reference to A_1 and O_z.)

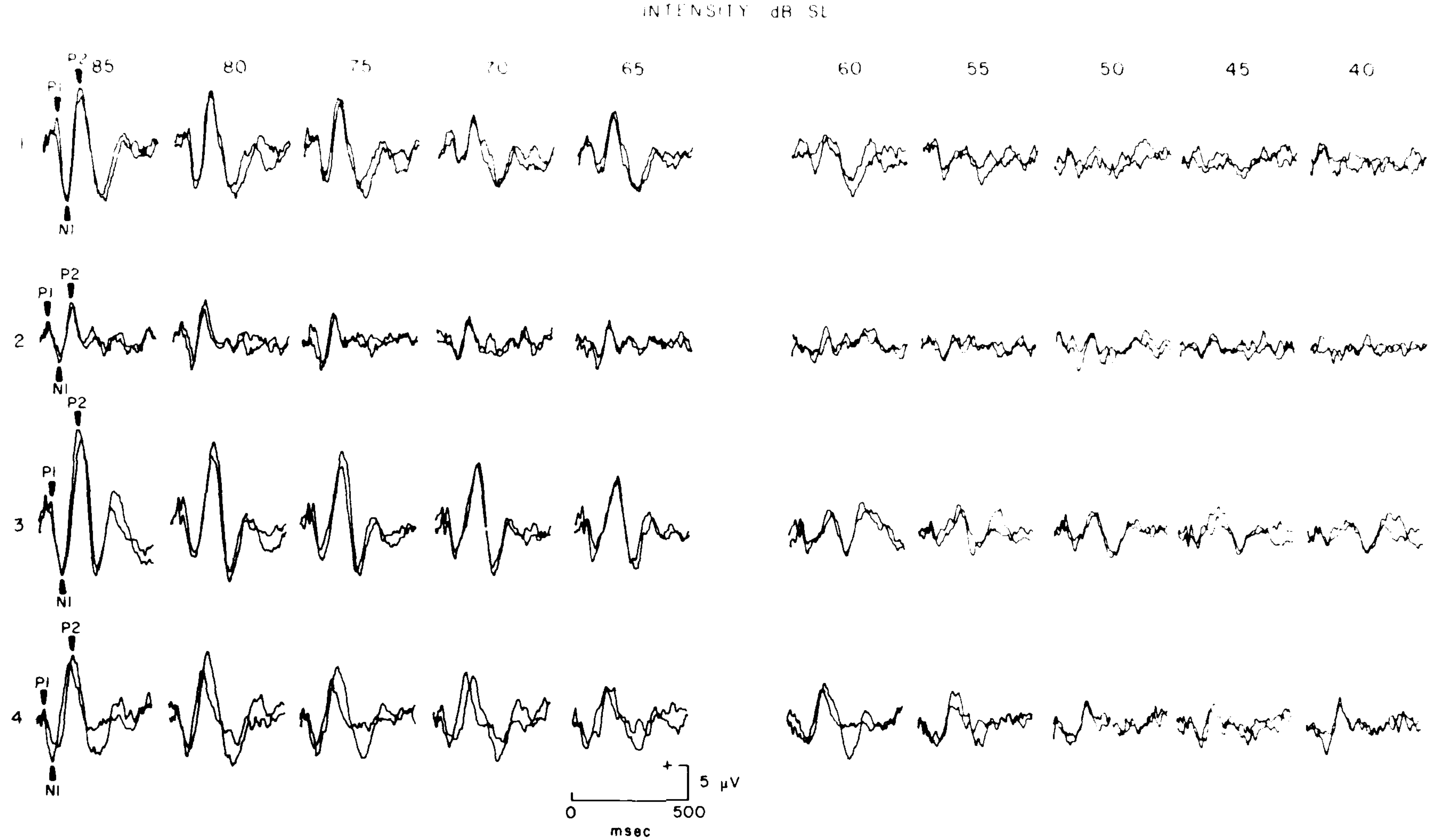


Figure 2. Monopolar (C_zA_1) auditory evoked potentials from four subjects. (Note that the 40- to 60-dB intensity series does not produce clear, consistent components. In addition, evoked potential amplitude does not appear continuous across the ten intensities, with a schism between 65 and 60 dB.)

RESULTS

Evoked potentials from the low-intensity series (40 to 60 dB SL) were small and difficult to measure in all but a few subjects (Figure 2). This may have been partially due to the method used to present the tone bursts. Stimuli of the same intensity presented in consecutive order result in a more coherent AEP than a randomized presentation (Pratt & Sohmer, 1977). However, in this study it was necessary to block-randomize the stimuli to control for the effects of shifts in arousal during the recording session. This analysis is based on data from the 65 to 85 dB SL tone bursts series.

Average auditory evoked potential amplitudes across the high-intensity range are presented in Table 1. The slopes were all positive, ranging from .09 to .21 μV/dB. Individual amplitude-intensity slopes are presented in Table 2, and as can be seen, few negative or reducing slopes were observed. There was one negative P1N1 slope at C_zA_1 (monopolar configuration). There were more negative slopes recorded with the bipolar configuration (C_zO_z); five for P1N1 and two for N1P2. The two N1P2 reducers were also P1N1 reducers.

Using visual evoked potential (VEP) measures to determine augmenting-reducing, Zuckerman et al. (1974) found a significant interaction between disinhibition (a subscale of Zuckerman's Sensation Seeking Scale) and intensity. This interaction indicated that individuals who were high disinhibitors were augmenters for the visual mode. That is, high disinhibitors had increasing VEP amplitudes with increases in intensity. In an effort to determine if auditory augmenters would also be high disinhibitors, we divided subjects into 2 groups of 10 based on disinhibition scores using Zuckerman's t-score norms for that scale (Zuckerman, 1979a). Separate fixed-effects factorial designs were analyzed for amplitude and latency data using ANOVAs, with peaks (P1, N1, and P2 for latency; P1N1 and N1P2 for amplitude), area (C_zA_1, C_zO_z), and intensity (65 to 85 dB) as within variables. Latency data showed the expected main effect for peaks, $F(2, 36) = 551.98$, $p < .001$; however, main effects for area, intensity, and disinhibition were not significant. A significant Disinhibition x Peak x Intensity interaction indicated low disinhibitors had a longer P2 latency at higher intensities.

Evoked potential amplitude significantly increased with increasing intensity, $F(4, 72) = 27.8$, $p < .001$. Main effects for area and peaks were also significant; C_zA_1 was 18 percent larger than C_zO_z, $F(1, 18) = 26.2$, $p < .001$, and N1P2 was 44 percent larger than P1N1, $F(1, 18) = 41.6$, $p < .001$. A significant Peak x Intensity interaction, $F(4, 72) = 10.2$, $p < .01$, indicated N1P2 augmented more rapidly than P1N1, with a greater difference between peaks at the highest intensity (Figure 3). A significant Area x Peak interaction, $F(1, 18) = 9.5$, $p < .01$, showed that N1P2 increased more at C_zA_1 than at C_zO_z. The main effect and interactions for disinhibition were not significant. The mean amplitude for the high and low disinhibitors were very close; the high disinhibition group had a mean amplitude of 5.6 μV and the low disinhibition group had a mean of 5.1 μV.

In agreement with other research (Goldman et al., 1983; Kohn & Coulas, 1985), Vando and Sensation Seeking Scale total scores were significantly

Table 1

Means and Standard Deviations for P1N1 and N1P2 Amplitudes by Intensity and Area

Area	Intensity dB SL	P1N1 $\bar{x}$ (μV)	P1N1 SD	N1P2 $\bar{x}$ (μV)	N1P2 SD
C_zA_1					
	65	3.30	1.69	5.73	2.38
	70	3.32	1.91	6.24	2.58
	75	4.03	2.13	7.71	3.14
	80	4.49	2.38	8.99	3.58
	85	5.72	2.51	9.66	4.20
r		.95		.99	
Slope		.12		.21	
C_zO_z					
	65	3.08	2.17	4.65	1.89
	70	2.76	1.71	4.92	1.84
	75	3.48	2.05	6.03	2.52
	80	3.90	2.15	7.17	3.41
	85	4.64	2.26	7.86	3.90
r		.92		.99	
Slope		.09		.17	

Note. *N* = 20. *r* = product-moment correlation. $\bar{x}$ = mean. *SD* = standard deviation.

Table 2

Subjects' Sensation Seeking Scale Scores (SSS); Correlations and Slopes of Auditory Evoked Potential Amplitude With Intensity

SSS Scores		C_zA_1				C_zO_z			
		P1N1		N1P2		P1N1		N1P2	
ES[a]	Dis[b]	r[c]	Slope[d]	r	Slope	r	Slope	r	Slope
8	4	.97	.35	.91	.42	.95	.34	.94	.51
8	4	.85	.08	.79	.09	.58	.04	.92	.10
7	7	.73	.15	.75	.10	-.79	-.11	.73	.09
7	5	.71	.07	.98	.26	.77	.16	.88	.24
7	2	.64	.08	.93	.15	.48	.03	.95	.08
6	6	.97	.16	.99	.34	.80	.12	.93	.29
6	3	.93	.20	.94	.39	.79	.13	.90	.33
6	7	.84	.29	.96	.50	-.04	-.01	.93	.34
5	8	.35	.04	.84	.14	.37	.03	.93	.18
5	7	.85	.18	.81	.19	.65	.13	.89	.26
5	2	.49	.07	.93	.15	.48	.07	.89	.17
5	1	-.59[e]	-.03	.92	.14	-.49	-.01	.75	.07
4	1	.94	.18	.98	.49	.86	.09	.89	.29
4	3	.86	.09	.71	.07	.88	.09	.96	.10
4	3	.45	.02	.84	.05	-.49	-.03	-.10	-.01
4	6	.72	.15	.84	.25	.80	.20	.68	.08
3	3	.71	.06	.42	.03	.93	.07	.42	.02
3	7	.88	.08	.87	.10	.73	.10	.90	.18
3	9	.35	.04	.88	.12	-.90	-.03	-.39	-.04
1	6	.24	.06	.89	.15	.91	.19	.47	.08
Pooled Mean		.94	.12	.98	.21	.91	.08	.98	.17

Note. Subjects are ranked by experience seeking scores.

[a]Experience seeking subscale of Sensation Seeking Scale.
[b]Disinhibition subscale of Sensation Seeking Scale.
[c]r = product-moment correlation.
[d]$\mu V/dB$.
[e]Underlined scores indicate a negative slope.

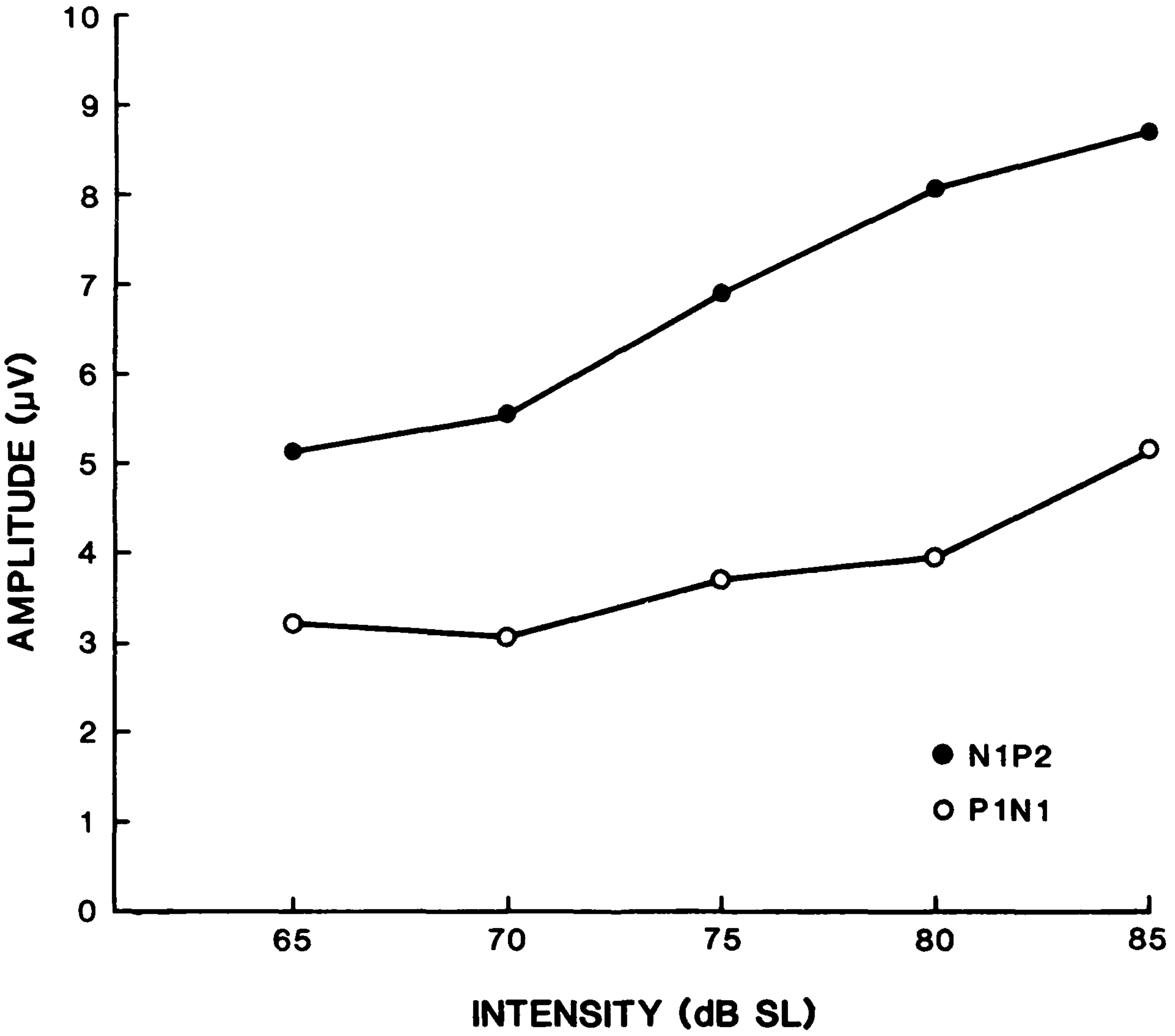


Figure 3. Peak by intensity interaction for evoked potential amplitude data.

correlated, $r(18) = .658$, $p < .001$. Vando and sensation seeking scores for the present subject population were comparable to those of normative data bases (Table 3). Correlations were computed between individual amplitude-intensity slopes with Vando and sensation seeking scores (Table 4). In reviewing the augmenting-reducing literature, Buchsbaum (1976) determined that the monopolar vertex P1N1 component was the optimal site to measure. As shown in Table 4, all the C_zA_1 P1N1 correlations with personality were positive with the experience seeking subscale reaching statistical significance. Experience seeking was also significantly correlated with C_zO_z N1P2 slopes indicating auditory augmenters are experience seekers.

DISCUSSION

These data indicate the relationship between cortical augmenting-reducing and sensation seeking is not dependent on sensory modality. The significant correlations between experience seeking and evoked potential slopes are in accordance with findings for the visual mode indicating augmenters are more likely to seek out novel, exciting experiences (Buchsbaum, 1971; Lukas, 1987; Zuckerman et al., 1974). Cortical augmenting-reducing has been related to a wide array of behaviors (Zuckerman, 1984). Augmenters perform better under high cognitive workloads (Lukas & Mullins, 1985); are more explorative, more active, and more aggressive than reducers (Lukas & Siegel, 1977b); and cope better with stress (Lukas & Siegel, 1977a). Therefore, this evoked potential technique offers an entree into the human nervous system and allows an assessment of how individual soldiers will cope with highly arousing, stressful experiences.

With the exception of the P1N1 components for C_zO_z, few auditory reducers were observed (Table 2). There was one vertex P1N1 reducer (5 percent) and five reducers using the bipolar C_zO_z site (25 percent). Klingaman and Anch (1972) compared monopolar and bipolar recording configurations and are in agreement with the present results. They found the average monopolar configuration had larger amplitudes and steeper P1N1 slopes. Studies comparing auditory and visual augmenting-reducing for the same subjects (Kaskey et al., 1980; Raine et al., 1981) also found that auditory reducing was not as prevalent as visual reducing. Approximately 50 percent of their subjects were visual reducers; whereas, only 3 to 7 percent were auditory reducers.

Why isn't auditory reducing as prevalent as visual reducing? Visual reducing is elicited using white light that activates all types of retinal cones. Most auditory studies use pure tone bursts, stimulating only a small portion of the basilar membrane. In an effort to make auditory and visual cortical stimulation analogous, Mullins and Lukas (1984) used gated white noise bursts. Reducing at P1N1 occurred in 50 percent of the subjects at C_zO_z and 38 percent at C_zA_1. Stimulating more receptors may activate more cortical neurons thereby initiating the inhibitory processes that produce evoked potential reducing.

Table 3

Vando and Sensation Seeking Scores for the Present Study in Comparison With Normative Data

	Present Study[a]		Normative Data	
Scales	$\bar{x}$	SD	$\bar{x}$	SD
Vando	26.90	7.17	29.13[b]	11.02[b]
SSS[d]				
TAS	7.90	2.40	7.35[c]	2.25[c]
ES	5.05	1.84	4.70[c]	1.96[c]
Dis	4.70	2.40	4.74[c]	2.40[c]
BS	2.40	1.95	2.65[c]	1.81[c]
SSS Total	20.05	4.78	19.49[c]	7.03[c]

[a] *N* = 20.
[b] *N* = 80; Vando's (1969) normative data base is based on a 54-point scale. The Vando scores in the present study are based on a 50-point scale.
[c] *N* = 1,023; Adapted from Zuckerman's (1979a) normative data base for American undergraduates.
[d] SSS = Sensation Seeking Scale; TAS = Thrill and adventure seeking; ES = Experience seeking; Dis = Disinhibition; BS = Boredom susceptibility.

Table 4

Correlation of Auditory Evoked Potential Slopes With Vando and Sensation Seeking Scale Scores

Peak	Area	Vando	Sensation Seeking Scale[a] TAS	ES	Dis	BS	Total
P1N1							
	C_zA_1	.052	.133	.431*	.130	.128	.357
	C_zO_z	-.026	-.057	.025	-.086	-.025	-.073
N1P2							
	C_zA_1	-.167	-.079	.310	-.050	-.110	.010
	C_zO_z	.082	.106	.488*	-.022	.076	.262

Note. *N* = 20.

[a]TAS = Thrill and adventure seeking; ES = Experience seeking; Dis = Disinhibition; BS = Boredom susceptibility.

*$p < .05$.

The present study utilized the classic augmenting-reducing paradigm where subjects are instructed simply to relax, consequently there is little or no control over what each subject is attending. However, the N1 component has a larger amplitude when tones are attended (Hillyard, Hink, Schwent, & Picton, 1973), and the P1N1 amplitude-intensity slope is clearly affected by the subjects' allocation of attention (Schechter & Buchsbaum, 1973). Since augmenting-reducing is determined by measurement of the P1N1 slope to an intensity series and since P1N1 amplitude is dependent on what the subject is attending, then it follows that augmenting-reducing studies must control what the subject actually attends. In support of this, Mullins and Lukas (1984) compared the classic passive augmenting-reducing paradigm with an attention paradigm where subjects attended the auditory stimuli and reacted with a button press to randomly occurring targets. Only the slopes from the attention paradigm were correlated with the Sensation Seeking and Vando Scales. Slopes in the passive paradigm were random and not significantly correlated with personality measures. It is tempting to speculate that controlling subjects' attention to the auditory stimuli would have enhanced the number of significant correlations with personality. Certainly, all future augmenting-reducing studies should control this important variable.

REFERENCES

Buchsbaum, M. S. (1971). Neural events and psychophysical law. Science, 172, 502.

Buchsbaum, M. S. (1976). Self-regulation of stimulus intensity: Augmenting/reducing and the average evoked response. In G. E. Schwartz & D. Shapiro (Eds.), Consciousness and self-regulation: Advances in research and theory (Vol. 1) (pp. 101-135). New York: Plenum Press.

Buchsbaum, M. S., & Silverman, J. (1968). Stimulus intensity control and the cortical evoked response. Psychosomatic Medicine, 30, 12-22.

Coursey, R. D., Buchsbaum, M. S., & Frankel, B. L. (1975). Personality measures and evoked responses in chronic insomniacs. Journal of Abnormal Psychology, 84, 239-249.

Goldman, D., Kohn, P. M., & Hunt, R. W. (1983). Sensation seeking, augmenting-reducing, and absolute auditory threshold: A strength-of-the-nervous-system perspective. Journal of Personality & Social Psychology, 45, 405-411.

Grinker, R. R., & Speigel, J. P. (1945). Men under stress. New York: McGraw-Hill.

Hillyard, S. A., Hink, R. F., Schwent, V. L., & Picton, T. W. (1973). Electrical signs of selective attention in the human brain. Science, 182, 177-180.

Kaskey, G. B., Salzman, L. F., Klorman, R., & Pass, H. L. (1980). Relationships between stimulus intensity and amplitude of visual and auditory event related potentials. Biological Psychology, 10, 115-125.

Klingaman, R. L., & Anch, A. M. (1972). Human auditory evoked response intensity functions from monopolar and bipolar scalp recordings. Psychonomic Science, 29, 17-19.

Kohn, P. M., & Coulas, J. T. (1985). Sensation seeking, augmenting-reducing, and the perceived and preferred effects of drugs. Journal of Personality and Social Psychology, 48, 99-106.

Lukas, J. H. (1987). Visual evoked potential augmenting-reducing and personality: The vertex augmenter is a sensation seeker. Personality and Individual Differences, 8, 385-395.

Lukas, J. H., & Mullins, L. F. (1985). Auditory augmenters are sensation seekers and perform better under high workloads (Abstract). Psychophysiology, 22, 580-581.

Lukas, J. H., & Siegel, J. (1977a). Aversive noise effects on performance and thalamocortical responsiveness in cats. Physiology & Behavior, 19, 555-559.

Lukas, J. H., & Siegel, J. (1977b). Cortical mechanisms that augment or reduce evoked potentials in cats. Science, 198, 73-75.

Mullins, L. F., & Lukas, J. H. (1984). Auditory augmenters are sensation seekers - if they attend the stimuli (Abstract). Psychophysiology, 21, 589.

Petrie, A. (1967). Individuality in pain and suffering. Chicago, IL: University of Chicago Press.

Petrie, A., Holland, T., & Wolk, I. (1963). Sensory stimulation causing subdued experience: Audio-analgesia and perceptual augmentation and reduction. Journal of Nervous and Mental Disorders, 137, 312-321.

Petrie, A., McCulloch, R., & Kazdin, P. (1962). The perceptual characteristics of juvenile delinquents. Journal of Nervous and Mental Disorders, 134, 415-421.

Pratt, H., & Sohmer, H. (1977). Correlations between psychophysical magnitude estimates and simultaneously obtained auditory nerve, brain stem and cortical responses to click stimuli in man. Electroencephalography and Clinical Neurophysiology, 43, 802-812.

Raine, A., Mitchell, D. A., & Venables, P. H. (1981). Cortical augmenting-reducing - modality specific? Psychophysiology, 18, 700-708.

Schechter, G., & Buchsbaum, M. (1973). The effects of attention, stimulus intensity, and individual differences on the average evoked response. Psychophysiology, 10, 392-400.

Vando, A. (1969). A personality dimension related to pain tolerance. Unpublished doctoral dissertation, Teachers College, Columbia University.

Vando, A. (1974). The development of the R-A scale: A paper-and-pencil measure of pain tolerance. Personality and Social Psychology Bulletin, 1, 28-29.

Zuckerman, M. (1979a). Abbreviated manual with scoring keys and forms for Form V of the Sensation Seeking Scale. Unpublished manuscript, University of Delaware, Newark.

Zuckerman, M. (1979b). Sensation seeking: Beyond the optimal level of arousal. Hillsdale, NJ: Lawrence Erlbaum Association.

Zuckerman, M. (1984). Sensation seeking: A comparative approach to a human trait. Behavioral and Brain Sciences, 7, 413-471.

Zuckerman, M., Murtaugh, T. M., & Siegel, J. (1974). Sensation seeking and cortical augmenting-reducing. Psychophysiology, 11, 535-542.

END

Feb.

1988

DTIC